Journal of Information Technology Education: Research

An Official Publication of the Informing Science Institute
InformingScience.org

JITEResearch.org

Volume 23, 2024

GENERATIVE AI SOLUTIONS FOR FACULTY AND STUDENTS: A REVIEW OF LITERATURE AND ROADMAP FOR FUTURE RESEARCH

Giulio F. Marchena Sekli*	CENTRUM Católica Graduate Business School, Lima, Perú Pontificia Universidad Católica del Perú, Lima, Perú	gmarchena@pucp.pe
Amy Godo	CENTRUM Católica Graduate Business School, Lima, Perú Pontificia Universidad Católica del Perú, Lima, Perú	a20184887@pucp.edu.pe
José Carlos Véliz	CENTRUM Católica Graduate Business School, Lima, Perú Pontificia Universidad Católica del Perú, Lima, Perú	jcveliz@pucp.edu.pe

* Corresponding author

ABSTRACT

Aim/Purpose	This paper aims to address the gap in comprehensive, real-world applications of Generative Artificial Intelligence (GenAI) in education, particularly in higher education settings. Despite the evident potential of GenAI in transforming educational practices, there is a lack of consolidated knowledge about its practical effectiveness and real-world impact.
Background	This study addresses this gap by conducting a systematic literature review to collate and analyze real-life instances of GenAI applications in higher education, thus providing a nuanced understanding of its practical implementations and measurable outcomes.
Methodology	The paper utilizes a systematic literature review methodology, adopting the PRISMA approach complemented by a thematic analysis procedure to ensure a comprehensive and in-depth evaluation of the literature. It synthesizes information from relevant articles from 2022 to 2024, focusing on the applications of GenAI in higher education. This analysis covers various aspects, including

Accepting Editor Peter Blakey | Received: April 1, 2024 | Revised: May 17, 2024 | Accepted: May 23, 2024.
Cite as: Marchena Sekli, G. F., Godo, A., & Véliz, J. C. (2024). Generative AI solutions for faculty and students: A review of literature and roadmap for future research. *Journal of Information Technology Education: Research, 23,* Article 14. https://doi.org/10.28945/5304

	research settings, analysis scales, data types, collection tools, and analytical methods.
Contribution	The paper contributes to the academic community by offering a comprehensive review of GenAI applications in education, highlighting the current precision level of these tools, and providing strategic recommendations for their effective use in academia. Furthermore, the research defines seven specific cases where Gen AI can be utilized as a reference for educational institutions in their adoption strategies.
Findings	Key findings include the versatility of GenAI in generating teaching materials, enhancing skill development, supporting student tasks, academic performance evaluation, feedback delivery, and its role as a virtual assistant and in research support.
Recommendations for Practitioners	Practitioners are advised to explore the integration of GenAI for diverse educational purposes, from content creation to student assessment, while being cognizant of its limitations and ethical considerations.
Recommendations for Researchers	Future research should focus on addressing the gaps identified, such as the implications of GenAI in research roles, its application in various disciplines, and the exploration of newly developed AI tools tailored to specific educational needs.
Impact on Society	The findings of this paper highlight the potential of GenAI in revolutionizing the educational sector, offering personalized learning experiences, and significantly influencing teaching methodologies and student engagement, but it also reveals significant deficiencies of Generative AI, known as hallucinations, which can impact the expected results.
Future Research	Subsequent research should explore the evolving capabilities of GenAI models, their impact on various academic disciplines, and the development of pedagogical strategies to optimize their use in education.
Keywords	generative AI, education, systematic literature review, teaching materials, skill development, academic performance

INTRODUCTION

Generative Artificial Intelligence (GenAI) has emerged as a transformative force in the educational landscape, with the potential to alter approaches to learning and teaching in academic environments. Its unique capacity for generating novel, relevant content across various mediums signifies a shift in the personalization and delivery of educational materials (Qadir, 2023). The increasing demand for personalized learning experiences and the integration of advanced technological tools in education has driven interest in the applications of GenAI. Traditional educational methods often struggle to address the diverse needs of students, and GenAI offers innovative solutions to these persistent challenges. For instance, by automating the generation of teaching materials or providing customized feedback, GenAI can significantly enhance the efficiency and effectiveness of educational practices (Grassini, 2023). Additionally, the rapid advancement of GenAI technology is continually demonstrating its potential across various fields, making it crucial to understand its capabilities and real-world applications in education to harness its full benefits effectively.

Beyond mere text generation, GenAI's applications in education encompass a broad spectrum of functionalities, ranging from offering real-time, customized feedback to students to aiding in sophisticated engineering simulations (Cooper, 2023; Ruiz-Rojas et al., 2023). GenAI harbors the potential

to reshape curricula, pedagogy, and student engagement, presenting unparalleled opportunities for personalized learning and interactive teaching methods. The integration of GenAI into educational practices heralds a significant transformation, particularly evident in curriculum design and instruction. Tools such as ChatGPT can aid educators in formulating comprehensive teaching plans and materials, conducting case studies, and promoting enriched classroom interactions (Yang et al., 2023). Additionally, GenAI's capacity to mimic student perspectives offers invaluable insights to novice educators, thereby enriching their teaching methods and anticipating classroom dynamics (Ruiz-Rojas et al., 2023). Moreover, GenAI's proficiency in analyzing educational data and adapting to various learning styles empowers institutions to refine their teaching strategies, thus enhancing educational outcomes and deepening the understanding of the learning process. This integration marks a new chapter in digital learning, where technology not only complements but substantially enriches the educational experience for both teachers and students (Dasari et al., 2024).

Despite all its potential, it is crucial to critically assess the quality and reliability of the results delivered to prevent potential misuse or over-reliance on AI-generated content. While GenAI tools can enhance educational experiences, their limitations, and potential risks must be carefully managed. The feedback generated by GenAI tools can sometimes be inaccurate or biased, which poses a risk if used uncritically by students and faculty. Ensuring human oversight is essential to validate and contextualize AI-generated feedback to maintain educational integrity and quality (Michel-Villarreal et al., 2023; Rose, 2023).

Even with the growing interest in GenAI, there is a notable absence of comprehensive studies that examine its real-world applications and effectiveness in educational settings. This gap in the literature hinders educators and policy makers from making informed decisions about integrating GenAI into educational practices. Many existing studies focus on theoretical possibilities without providing empirical evidence of their impact. To effectively integrate GenAI into education, it is essential to understand both its potential benefits and its limitations through empirical research (Bahroun et al., 2023; Ha et al., 2023).

Understanding the practical applications of GenAI in education is crucial for leveraging its full potential. This study aims to offer valuable insights for educators, researchers, and policymakers by providing a detailed analysis of how these tools are currently used and their impact on educational outcomes. By highlighting the benefits and identifying the shortcomings of GenAI tools, such as their tendency to generate inaccurate or biased content, this study seeks to develop guidelines and best practices for their use. For instance, while tools like ChatGPT can offer real-time, customized feedback to students, the quality and reliability of such feedback must be critically assessed to prevent potential misuse or over-reliance on AI-generated content (Ossa & Willatt, 2023).

Numerous studies have proposed scenarios and suggested methodologies for employing GenAI in education. However, there is a notable absence of a holistic view that consolidates practical, real-world instances where GenAI has been applied and the tangible results achieved. This gap underscores the need for comprehensive investigations that not only explore theoretical possibilities but also examine the actual effectiveness of GenAI in educational settings. Such research is essential to provide empirically grounded insights into the actual capabilities and limitations of GenAI in enhancing educational practices (Ross, 2023; van den Berg & du Plessis, 2023).

Therefore, this study endeavors to conduct a systematic literature review (SLR) to identify research where GenAI has been effectively employed in higher education institutions, documenting substantial findings. This SLR aims to keep pace with the rapid progression of scientific publications and accelerate understanding of specific concepts (Sharadgah & Sa'di, 2022). By doing so, it also eases researchers' ability to identify existing gaps from prior research and potential novelties for future studies. SLR plays a vital role in supporting further research endeavors. Evaluating progress over the years is significant, and this study synthesizes 44 relevant research articles, analyzing the trend of Generative AI in education research from 2022 to 2024 across several aspects, including underlying

issues, research settings, analysis scales, data types, collection tools, analytical methods, and contributions.

This initiative serves multiple objectives: First, it will assemble a collection of applied case studies to inform higher education institutions aspiring to integrate GenAI. Second, it aims to deepen our comprehension of the current precision level of GenAI and to offer strategic recommendations for its application in this domain. Ultimately, this study intends to uncover gaps in our current understanding, pinpointing areas in need of additional exploration or pragmatic application, thereby aiding the advancement of learning processes for educators and students alike. An inclusive review of this nature is imperative to provide a clear and exhaustive depiction of GenAI's role in higher education, transitioning from theoretical possibilities to practical implementations and quantifiable outcomes (Karakose et al., 2023; Lim et al., 2023; Mhlanga, 2023).

By synthesizing real-life applications and measurable impacts, this research will establish a foundational basis for future GenAI integrations in higher education, delineating a concrete route for its thoughtful and efficacious incorporation in modern educational frameworks (Pavlik, 2023; Perkins, 2023; Psiropoulos et al., 2016).

Accordingly, this research addresses the following questions:

RQ1: What is the prevailing state of current and applied research on Generative AI in education?

RQ2: What challenges are faced by contemporary research on Generative AI in education?

RQ3: What potential gaps exist in the literature on Generative AI in education that warrant additional investigation?

Subsequent sections will elucidate the criteria for selecting research articles for review and present a descriptive analysis of the chosen papers. The discussion will then extend to the future trajectory of studies in this area.

METHODOLOGY

Systematic reviews often lack awareness of established guidelines essential for ensuring their replicability and scientific adequacy. This study employs the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology, depicted in Figure 1, to conduct a Systematic Literature Review (SLR) in a methodical and transparent manner. PRISMA offers a standardized and widely accepted methodology, employing a checklist guideline strictly adhered to in this paper, thus enhancing the quality assurance and replicability of the review process.

For the research, we used the PRISMA checklist to ensure adherence to systematic review standards, enhancing the transparency and replicability of the study. The PRISMA technique involves various steps of the review process, including identification, screening, eligibility, and exclusion criteria. Additionally, the steps of data abstraction and analysis are exemplified (Ismail et al., 2021a, 2021b; Moher et al., 2009). Consequently, the PRISMA approach proves beneficial for SLR research, as it employs systematic stages to accomplish the study's objectives.

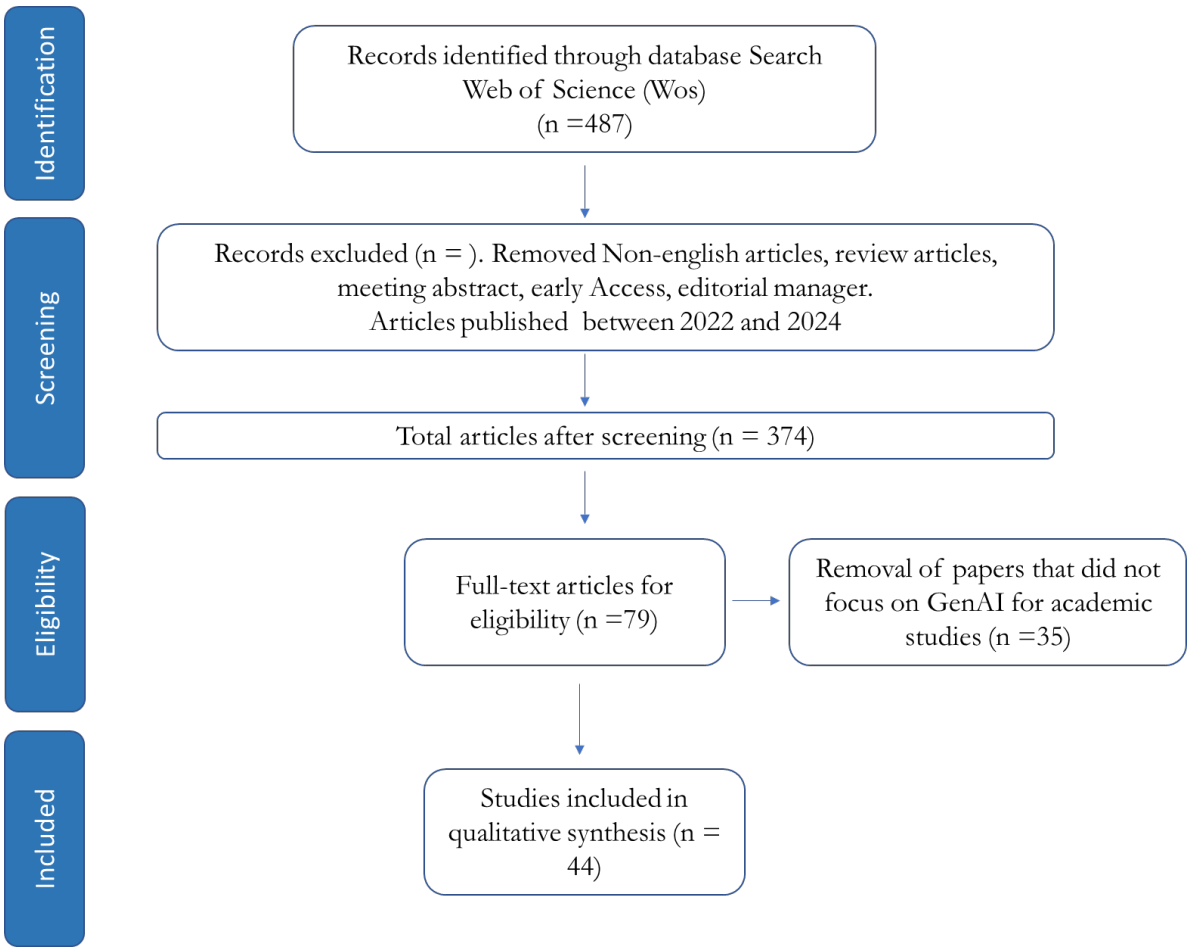

Figure 1. PRISMA methodology to conduct systematic literature review (adapted from Moher et al., 2009)

IDENTIFICATION

The initial phase of the systematic literature review process entails identifying pertinent keywords for conducting searches (Ismail et al., 2021a, 2021b). These keywords are then employed to craft search strings customized for the search functionalities provided by digital libraries. Following the recommendation by Moher et al. (2009) to utilize at least one database, in this study, a prominent database such as the Web of Science (WoS) was chosen. WoS is widely acknowledged as a primary and extensively utilized resource, particularly in fields closely related to the social sciences, for conducting research on science mapping (Zupic & Čater, 2015).

The selection of search terms was informed by an initial review of existing literature in the field of generative AI solutions for academic use, considering potential variations in keyword usage (López-García et al., 2021). The determination of keywords stemmed from discussions and advice received from recognized experts in the field.

To ensure consistency in results, separate preliminary searches were conducted initially, considering various popular generative AI models in the market, such as ChatGPT, Llama2, and BLOOM, among others, identifying a significant concentration of studies applied in education based on ChatGPT. Additionally, preliminary searches were conducted to ensure coverage of studies using different synonyms related to faculty and students to explore GenAI solutions for academic use. Subsequently, a general search formula was devised. Finally, the search strategy employed in the Web of Science (WoS) database was formulated as follows:

> TS = ("Generative AI" OR "Generative Artificial Intelligence" OR "ChatGPT" OR "GPT") AND TS = ("Teacher" OR "professor" OR "teaching" OR "Instructor" OR "Tutor" OR "Student")

Semantic analysis involves understanding the paradigmatic and syntagmatic axes of words, employing distributional semantics to infer word meanings based on their contexts. Distributional semantics, as described by Boschetti (2019), enables the identification of semantic similarities and differences by analyzing co-occurrence patterns in large textual corpora, thus providing a deeper understanding of the context and meaning of terms used in the selected studies. In defining our keywords, we analyzed their distributional properties within educational and AI-related corpora, ensuring that terms like "Generative AI," "ChatGPT," and "teaching" capture both explicit and implicit meanings related to our study's focus. A bottom-up approach was adopted to enhance the robustness of our semantic analysis; text data from various studies were analyzed to identify emergent patterns and themes without predefining categories and to analyze co-occurrence patterns and semantic relationships within the text.

Screening

All articles identified from the WoS database, stemming from the search conducted in the identification phase, proceed to the subsequent phase. The screening process serves as a pivotal stage wherein publications are scrutinized for inclusion or exclusion based on criteria established by the authors (Ismail et al., 2021a, 2021b; Moher et al., 2009). Throughout the screening phase, specific inclusion and exclusion criteria are delineated to identify pertinent publications for inclusion in the systematic review process. In this study, a publication timeline is initially established, spanning from 2022 to 2024, aligning with the emergence of GenAI studies, particularly with the public release of ChatGPT towards the end of 2022.

The second inclusion criterion pertains to the document type, with preference given to journal articles. Other document types, such as review articles, abstracts, conference papers, book reviews, and book chapters, are excluded as they are not deemed primary sources. Language serves as the third criterion for inclusion and exclusion. Non-English language documents are excluded to mitigate translation difficulties and potential confusion. Following the completion of the screening process, a total of 374 articles have been identified.

Eligibility

The eligibility process entails a manual assessment in which articles are assessed for inclusion or exclusion based on specific criteria established by the authors (Ismail et al., 2021a, 2021b). During this procedure, the obtained articles undergo a thorough evaluation, and any papers that do not meet these criteria are excluded.

Through meticulous scrutiny of the titles, abstracts, and conclusions of each study involving three reviewers, research works demonstrating practical applications of GenAI within academic institutions were identified, with the goal of highlighting and consolidating real experiential learning. Conversely, studies that solely provided usage recommendations were excluded; any discrepancies were resolved through consensus among the reviewers. Additionally, studies lacking full text were eliminated; subsequently, a single reviewer synthesized all results into a single document. Ultimately, 44 articles were selected during the eligibility process.

Data Abstraction and Analysis

The fourth phase involves the abstraction and analysis of data. The selected articles undergo evaluation, review, and analysis. In this study, the 44 chosen articles are thoroughly examined. Through a comprehensive reading of the entire text, relevant themes are extracted from the studies for the current investigation. An integrative review, as illustrated in Figure 2, is conducted.

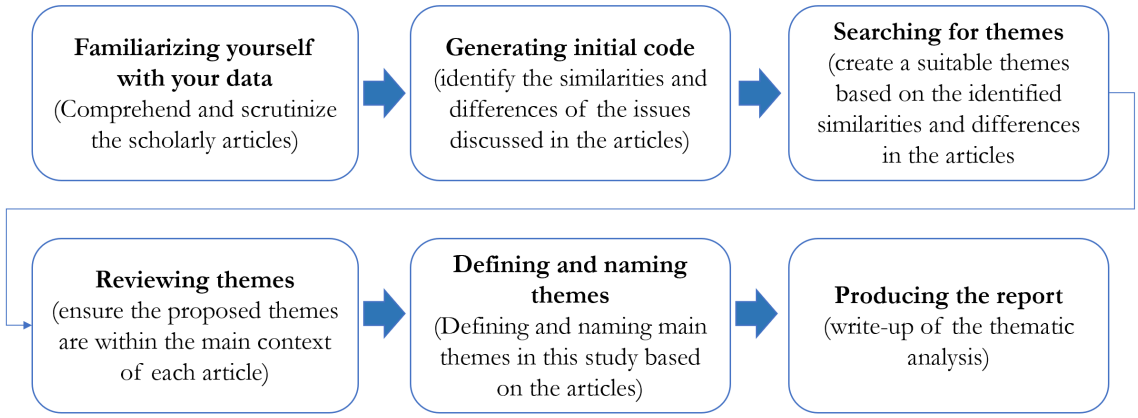

Figure 2. Thematic analysis in systematic literature review (adapted from Hijriyah et al., 2023)

Thematic analysis is employed to explore themes pertinent to research trends in GenAI studies related to academic institutions. Recognized as an independent qualitative descriptive approach, serves primarily to identify, analyze, and report patterns (themes) within the data. Thematic analysis, being a flexible and valuable research tool, yields comprehensive and detailed data (Vaismoradi et al., 2013). It identifies and categorizes major issues, similarities, and differences outlined in the 44 articles.

In this systematic literature review study, six processes within thematic analysis are utilized to formulate themes suitable for qualitative analysis, as outlined by Nowell et al. (2017). The listed studies are arranged chronologically by year of publication and alphabetically by the first author's name. Finally, the Appendix presents all the papers included (n = 44), which will be utilized in the subsequent section to discuss the results of the analysis.

DISCUSSION

The literature review conducted through the developed methodological process allowed us to identify seven themes or activities in which GenAI tools were used by faculty and students, as can be seen in Table 1. In this section of the study, we will present the main findings that previous studies have obtained when using GenAI in various educational institutions.

GENERATION OF TEACHING MATERIALS

The literature review revealed an increasing number of studies applying Generative AI as a supportive tool for teachers in creating teaching materials. Among these studies, Carrasco Rodriguez's (2023) work stands out, utilizing ChatGPT to develop theoretical content, exercises, and practical activities for modern history education in secondary schools. The study examines ChatGPT's integration in teaching about Charles V's reign, suggesting how it contributes to the creation of educational resources and the implementation of innovative teaching approaches.

In the research conducted by Smith et al. (2023), ChatGPT is employed in specialized educational methods for social psychiatry. It assumes roles in educational settings such as an information provider, debate facilitator, self-directed learning supporter, and course material content creator. The study highlights its use in generating a hypothetical case relevant to social psychiatry, validated by the Department of Forensic Psychiatry at the University of Bern, Switzerland.

Other applications have utilized Generative AI to create diverse materials, such as preparing presentation slides, formulating essay and multiple-choice questions, and crafting personalized content based on comprehension ability. This was evidenced in a study supporting content generation in medical education (Mondal et al., 2023). van den Berg and du Plessis (2023) also employed ChatGPT

to construct teaching materials for English classes, using prompts like "Can you design an English second language lesson on prepositions for Grade 6 learners?" and refining them through use; additionally, they generated prompts for creating class presentations.

Table 1. Compilation of research studies employing GenAI tools

Activities in which GenAI tools were used by faculty and students	Generative AI tools employed	Related research studies (DOI)
Generation of teaching materials	ChatGPT 3.5, Mplus	10.21577/0100-4042.20230059; 10.1111/opo.13207; https://hdl.handle.net/10125/7353010.1016/j.acpath.2023.100099; 10.3390/educsci13100998; 10.4103/ijves.ijves_37_23; 10.1007/s10639-023-12249-8; 10.1177/00207640231178451; 10.1177/10944281231215024; 10.14201/shhmo2023451101146; 10.4103/idoj.idoj_72_23;
Skill development	ChatGPT 3.5, ChatGPT 4.0, GPTZero	10.3390/languages9010005; 10.1080/03323315.2023.2284901; 10.3389/feduc.2023.1295413; 10.30935/cedtech/13176; 10.1007/s10639-023-11834-1; 10.3389/feduc.2023.1251163; 10.30935/cedtech/13417; 10.1021/acs.jchemed.3c00505; 10.1177/00178969231197371; 10.1108/JME-06-2023-0043; 10.1186/s41239-023-00427-0
Student task development support	ChatGPT 3.5, Dall-E, MidJourney, Codex	10.1080/10447318.2023.2269006; 10.1386/eta_00143_1; 10.3390/mti7080081; 10.1111/cts.13723; 10.1177/03064190231166665; https://doi.org/10.1111/dsji.12306
Academic performance evaluation	ChatGPT 3.5, ChatGPT 4.0, BLOOM-large, BLOOMz	10.1080/02602938.2024.2301722; 10.2967/jnmt.123.266485; 10.1016/j.mex.2023.102531; 10.1080/2331186X.2023.2210461; 10.1177/07356331231191174;
Feedback delivery	ChatGPT 3.5, ChatGPT 4.0	10.3991/ijep.v13i8.45621; 10.1186/s41239-023-00425-2; 10.3390/educsci13090885; 10.32457/ejep.v16i2.2412; 10.1007/s11423-023-10239-8; 10.1007/s10639-023-12146-0;
Virtual assistant (chatbot)	ChatGPT 3.5, ChatGPT 4.0, LangChain	10.3390/app132212446; 10.3390/bdcc8010002
Research support	ChatGPT	10.14742/ajet.8843

Lastly, studies have also explored GenAI for generating assessments, as seen in the work of Ngo et al. (2024). Based on self-learning guides for medical school immunology, as part of a course at the Boston University Chobanian and Avidesian School of Medicine's faculty of Pathology and Laboratory Medicine, they created multiple-choice questions, which were later reviewed and adjusted for use in a final exam.

Skill Development

GenAI has been instrumental in enhancing various skills, notably critical thinking abilities. For example, ChatGPT was introduced to first-year undergraduate students participating in the Critical Skills program at Maynooth University (Kirwan, 2023). They were tasked with developing prompts like "Write a business plan for an exploration of Mars" and refining the AI-generated outputs, thereby honing their writing skills. Similarly, introductory chemistry courses at Georgia Gwinnett College (Y. Guo & Lee, 2023) leveraged ChatGPT to assist students in writing essays and evaluating their outcomes. This approach significantly enhanced students' self-perception of their critical thinking skills, especially in formulating questions, evaluating information, and understanding complex subjects.

Other studies employed GenAI for more specific skill sets, like developing intercultural communication through telecollaboration (McCallum, 2024). The lesson demonstrated how GenAI tools in L2 language classrooms aid both teachers and international students preparing for studies abroad. In a different study, ChatGPT's influence on eleventh graders' learning in electronic magnetism was examined in the United Arab Emirates (Alneyadi & Wardat, 2023). Another study highlighted significant improvements in medical terminology knowledge (Hsu, 2023).

In language learning, various research employed GenAI for tasks like explaining grammatical concepts, analyzing inflected forms (Ross, 2023), enhancing writing skills (A. Barrett & Pack, 2023), and practicing communication through methods like ChatGPT-supported role-play (Zadorozhnyy & Lai, 2024). In another example within the language field, a study conducted by Jeon and Lee (2023) in a school in South Korea highlighted the innovative use of GenAI in language teaching. Ten teachers employed the chatbot as a conversational partner, specifically for role-playing exercises and interactive gaming. These educators utilized the role-play feature of ChatGPT to furnish students with practical language experiences. To initiate these role-plays, the teachers introduced a variety of prompts such as "Act as a person …" All ten teachers demonstrated to their students how to engage in a conversation with the chatbot, subsequently encouraging the students to actively participate in these dialogues.

Furthermore, some studies focused on developing multiple skills simultaneously. In March 2023, the Institute for the Future of Education (IFE) at Tecnológico de Monterrey introduced a program for International Relations and Economics dual degree students. This program not only taught students how to use new GenAI tools and understand prospective methods but also reinforced key competencies like communication, critical thinking, and logical reasoning (Michalon & Camacho-Zuñiga, 2023).

Student Task Development Support

Various studies have demonstrated GenAI's impact in assisting students with diverse assignments. For instance, Popovici's (2023) study showcased ChatGPT's use in solving exercises from a functional programming course at Bucharest Polytechnic University, underscoring the need to develop new capabilities beyond just coding. In a University of Pennsylvania postgraduate course on vaccine development, students utilized ChatGPT to draft business plans and presented them in a shark tank-style format (J. S. Barrett et al., 2024).

During an elective course in Finland, GenAI was integrated into an arts and crafts course, allowing students to co-create digital art (Vartiainen et al., 2023). Similarly, undergraduate mechanical engineering students used GPT-3 for writing laboratory reports and Codex for automating control systems labs, exploring the feasibility of completing assignments using GenAI tools (Lesage et al., 2024).

Academic Performance Evaluation

Assessment of textual responses in pedagogical environments proves to be laborious and demands substantial resources; hence, several studies documented in the scholarly literature have implemented GenAI for this task. Tobler (2024) details how a Swiss university devised a web application integrated

with the OpenAI API key, enabling the creation of a method wherein open-ended responses, along with their model solutions and grading rubrics, can be used to automatically evaluate a large volume of student submissions.

Conversely, in a Bachelor of Business Administration in Human Resource Management (BBA-HRM) program hosted by a prestigious private sector higher education institution in Abu Dhabi, a range of assessments were developed. These included case analyses, empirical study reports, self-reflective group work, and calculation-based tasks to test the efficacy of ChatGPT in tackling a spectrum of assessments at varying levels of complexity. Instructors utilized these assessments to ensure the cultivation of vital skills in students as they endeavored to resolve them (Chaudhry et al., 2023).

Finally, the research by Urrutia and Araya (2024) introduces the application of various Generative AI models, such as GPT-3, Bloom, and YouChat, to examine fourth-grade students' responses to open-ended mathematics questions, which potentially imparts a more enduring impact on learning compared to multiple-choice queries.

Feedback Delivery

Feedback as an evaluative practice is crucial for the enhancement of learning processes across all educational levels, as it provides students with pertinent information to comprehend and assess their performance. In this category of GenAI application in education, studies such as Ossa and Willatt (2023) have been highlighted. They introduce a process called RECaP-GPT, which integrates human action and employs ChatGPT-4 as an instructional support tool. This process provides descriptive feedback on 578 responses to pedagogical case studies based on predefined criteria known to students from seven different undergraduate pedagogy programs at the Faculty of Education, Universidad Autónoma de Chile.

In another study with undergraduate and postgraduate students across 90 classes at the University of Cantabria in Spain, the GPT-3 model was used to categorize responses to open-ended questions with prompts like "Classify the comments in one of the following categories" (Álvarez-Álvarez & Falcon, 2023).

Lastly, in K. Guo and Wang (2023), the role of ChatGPT in supporting teachers' feedback through the assessment of English argumentative essays written by Chinese university students was examined. In this study, 50 essays written by Chinese undergraduate students (24 males and 26 females) served as the focus for feedback provision.

Virtual Assistant (Chatbot)

In this category, one study has been identified that utilizes GenAI to develop chatbots catering to various needs. One such virtual assistant is EduChat, a chatbot system designed for university-related queries, proving particularly beneficial to the administrative sector of a university (Dinh & Tran, 2023). This system was developed based on the analysis of 625 text messages from interactions with students, involving six academic advisors and two student affairs staff members from Ho Chi Minh City University of Foreign Languages and Information Technology and Tien Giang University. By blending rule-based methods with an innovative approach to enhanced machine learning, utilizing an advanced version of the random forest algorithm in conjunction with ChatGPT, they successfully created a chatbot capable of addressing common questions about university programs, academic procedures, admission processes, student life, and other related topics. This led to the development of a chatbot adept at responding to inquiries such as, "The Student Affairs Office, I would like to ask how to go about obtaining a student certificate?"

Research Support

Finally, an article by Dai et al. (2023) explored the application of GenAI in research settings. Participants in this study were students enrolled in the Master of Philosophy and Doctor of Philosophy

programs at a research university in Australia. These programs were chosen due to their strong emphasis on research and the significant component of research supervision they entail. Students utilized ChatGPT extensively in their research projects; predominantly, they used ChatGPT for personalized tutoring and topic explanations, followed by language editing and text correction. Additionally, ChatGPT was employed for brainstorming and concept development, literature processing and synthesis, as well as code interpretation and debugging. The technology also played a role in facilitating mock interactions and rehearsals, with ChatGPT assuming specific roles in presentation practice exercises.

RESEARCH GAPS, CHALLENGES IN GENAI USAGE FOR EDUCATION, AND RECOMMENDATIONS FOR FUTURE RESEARCH

While previous literature reviews (Ansari et al., 2023; Lo, 2023) have been conducted prior to this research, none of them specifically focus on identifying concrete cases where Generative AI has been applied in educational institutions, which would allow for the identification of real challenges and gaps in the use of this rapidly evolving branch of AI. The literature review conducted enables us to examine the gaps identified in previous research, highlighting areas where further exploration and understanding are needed. Additionally, specific challenges faced when using or implementing Generative AI (GenIA) in educational environments are presented, including technical obstacles inherent to the maturity state of this AI branch, pedagogical challenges arising from the recent knowledge and potential use of the technology, and even ethical considerations. Considering these gaps and identified challenges, recommendations for future research are provided, outlining promising directions to maximize the potential of GenIA for faculty and students.

One aspect concerns the referencing of non-existent articles and inconsistent sources, suggesting that tools like ChatGPT may demonstrate variability in their ability to retrieve accurate and dependable information. This phenomenon was demonstrated in Y. Guo and Lee's (2023) study, where the use of ChatGPT to assist students in essay writing led to the identification of non-existent references, resulting in the creation of inaccuracies, commonly known as hallucinations. It would be compelling to observe how upcoming Generative AI models, such as the anticipated GPT-5, address this issue. For instance, in Walters and Wilder's (2023) investigation of medical citations, GPT-3.5 exhibited a hallucination rate of 55%, whereas GPT-4 showed a rate of 18%. Citations represent particularly vulnerable areas for large language models (LLMs), along with mathematical operations and word puzzles. However, a discernible trend towards diminishing hallucinations is evident across numerous assessments. Future research in educational institutions is imperative to showcase the contribution of GenAI in research endeavors, the creation of instructional materials, or the completion of tasks like student essays while considering the advancements in citation practices that future Large Language Models (LLMs) are achieving.

Another significant aspect underscores the necessity for enhanced training in the utilization of GenAI tools across diverse educational contexts. For instance, in the research conducted by Michalon and Camacho-Zuñiga (2023), despite initial self-perceptions of proficiency among students with tools like ChatGPT, the study revealed a steep learning curve for effective tool utilization. This finding challenges the concept of "digital natives," suggesting innate technological proficiency among young individuals. Additionally, in the study by Y. Guo and Lee (2023), students noted shortcomings in the depth and extent of responses generated by ChatGPT. This underscores the importance of investigating the impact of acquiring skills such as prompt engineering on educators, researchers, and students, enabling them to achieve more precise outcomes with GenAI. Prompt engineering, as described by Oppenlaender et al. (2023), is a novel skill requiring practice and learning before effective implementation. It is becoming increasingly crucial to interact with large language models (LLMs) like ChatGPT. Prompts serve as instructions to enforce rules, automate processes, and

ensure specific qualities and quantities of generated output, as discussed by White et al. (2023). Future research could explore the implications of acquiring this skill in various faculty and student tasks. Moreover, it advocates for the inclusion of prompt engineering in educational curricula, as referenced, to address the evolving importance of this skill in the coming years.

One notable aspect highlighted in the literature is the lack of precision exhibited by GenAI tools for certain activities, particularly in reviewing open-ended questions. For instance, studies such as Urrutia and Araya (2024) evidenced that the model utilized yielded poor results in reviewing fourth-grade students' responses to open-ended mathematics questions. Similarly, in the case of Ngo et al. (2024), for a medical school immunology exam comprising 60 generated questions, only 32% were deemed completely accurate and provided adequate explanations for the answers. These findings suggest that GenAI is still not suitable for reliably generating certain types of content without extensive editing by instructors. Despite these limitations, it is acknowledged that ChatGPT can still be useful for creating practice exams, provided significant adjustments and revisions are made. Future research should continue to evaluate the potential of GenAI tools to support the assessment of open-ended responses across various learning disciplines and the potential to assist educators in providing more detailed and valuable feedback to students.

An important gap identified in the research reveals an opportunity to further explore the use of GenAI tools to support not only teachers and students but also administrative staff within an educational institution. The research by Dinh and Tran (2023) unveiled the potential in this regard with EduChat, a chatbot capable of addressing common questions about university programs, academic procedures, or admission processes. Future research could consider evaluating the integration of GenAI into these types of tasks, in particular, exploring the use of GPT-4 and the possibility of creating their own chatbots thanks to the latest powerful feature added to ChatGPT, where non-programmers can create and share their own GPTs (Masters et al., 2024).

Another gap identified is the lack of studies addressing the use of GenAI as support for research. The study by Dai et al. (2023) highlighted how students used ChatGPT for activities such as topic explanations, language editing, and text correction. Additionally, it was evidenced that GenAI acts not just as a facilitative tool but also as an epistemic partner in the research journey. Future research should consider the implications of using GenAI in the field of research. On the one hand, research supervisors or mentors may shift their role from traditionally guiding students through the technical and complex aspects of their research to a more mentorship-oriented role. Another aspect to evaluate is the potential impact of future overreliance of students on GenAI for research development, something that should also be studied for teachers engaged in research tasks. This prompts the study of how much could be lost in skills acquired when processing texts firsthand, potentially inhibiting the development of deep comprehension and written communication skills.

Another significant gap identified in the research is the lack of exploration in the use of various Generative AI tools that emerged in 2023 and continue to evolve in 2024. It has become evident that the most widely used and applied tool in education has been ChatGPT, which can be attributed to the maturity and initial release of this platform created by OpenAI. However, the rapid development in the field of AI invites educators to conduct research using tools that are specifically developed to support specific activities with generative AI. For example, in the study by Popovici (2023), where ChatGPT was used to support students in solving programming activities in a functional programming course, there is a suggested need for a significant reconsideration of programming curriculum and teaching methodologies, considering new generative AI tools tailored to this teaching need. This calls for more research exploring the use of various tools for specific teaching or research scenarios. In the case of programming education, powered by recent advances in code-generating models, AI assistants like Github Copilot promise to change the face of programming forever (Porter, 2024). In fact, in line with Popovici's (2023) recommendation to reconsider curricula, it is important to address the effect that Generative AI will have on various subjects of teaching. Following the case of programming careers, platforms like Devin could replace the activities of a developer (Cardoso, 2024).

These implications and the reorientation of education to train professionals in an era of AI must be addressed.

Similarly, in the field of research, there are emerging tools such as Perplexity (Deike, 2024), or literature review tools like Litmaps (Ibrahimov, 2023). In the case of supporting educators, various Generative AI tools are being explored, such as Fireflies for summarizing and obtaining insights about classes delivered in virtual classrooms (Heinrichs, 2024), Tome for presentation generation (Galli, 2024), or Quiz Wizard for creating assessments (Bonnet, 2023), among others. Furthermore, it will be valuable to evaluate the new GenAI models that major corporations are releasing to the market, such as Google's Gemini (Banks & Warkentin, 2024) and Mistral AI, recently acquired by Microsoft (Boyd, 2024). Even the literature evidenced that the majority of studies applied the free version of ChatGPT, indicating the opportunity to expand this research field with the current model, GPT-4, which offers greater accuracy, contextual understanding, and generative capabilities (Álvarez-Álvarez & Falcon, 2023).

Finally, it is important to underscore the significance of ethical considerations surrounding the use of artificial intelligence in academic contexts, which are still in the nascent stages of understanding. With the introduction of new tools like ChatGPT, it becomes increasingly complex to define the boundaries of academic integrity and address potential instances of academic dishonesty. The use of GenAI raises concerns regarding plagiarism, authorship, and inappropriate dependency. Additionally, the inherent bias in AI algorithms, issues of fairness, and the potential for misuse are significant ethical dilemmas that require thorough discussion and resolution (Dai et al., 2023).

In summary, and addressing the first research question, the current state of applied research on Generative AI highlights the need to approach the use of GenAI tools with caution due to the level of hallucinations present in some use cases in the education sector. It is crucial to critically analyze the results to achieve the expected potential. However, it is important to note the rapid advancement of models that are likely to soon reduce these levels of hallucination, and it is advisable to address them promptly.

Regarding the second research question, there is ample scope for further development of practical use cases where Generative AI can become an assistant for teachers and students by acquiring new skills such as prompt engineering and promoting these cases to develop comprehensive strategies in educational institutions.

Finally, concerning the third research question, several gaps have been identified that underscore the need for further research. Issues such as inconsistency in provided sources, a lack of evidence in practical support cases not only for teachers and students but also for administrative staff, opportunities in research support, and a high concentration of studies using ChatGPT reveal a lack of investigation into education-oriented tools all indicate significant gaps that need to be addressed in future research.

Generative AI is evolving rapidly and significantly, as evidenced by the recent releases of GPT-4o (OpenAI, 2024) and Gemini 1.5 (McHugh-Johnson, 2024) in May 2024. These models present substantial opportunities for educational research. GPT-4o's "omni" capabilities allow it to process and generate outputs across text, audio, and image modalities in real-time, enhancing its utility in education. For example, GPT-4o can integrate text explanations with corresponding images and audio feedback, creating a more immersive and interactive learning experience. This multimodal approach caters to various learning styles, making education more accessible and engaging, such as creating a history lesson where GPT-4o provides text descriptions of historical events, accompanies them with relevant images, and plays related audio clips, all within a single, cohesive lesson plan. Google's Gemini 1.5, on the other hand, has demonstrated its ability to process and reason across extensive educational materials, such as entire courses or multiple semesters of lecture recordings, providing a holistic view of the learning journey. It will be interesting to see the practical applications for education

and the challenges that may arise. As Dr. Ethan Mollick mentions, "Cheating will become ubiquitous, as will universal high-end tutoring, creating an interesting time for education" (Mollick, 2024).

We recommend that future research use the new generative AI models based on the clusters identified in this study to generate practical use cases that demonstrate their potential for education. Additionally, it is important to verify the level of hallucination and accuracy in their results to support faculty and students effectively.

CONCLUSIONS

This research has undertaken a comprehensive examination of existing literature on the application of Generative Artificial Intelligence (GenAI) in educational contexts, particularly focusing on higher education. Through a systematic literature review, we have identified and analyzed practical applications of GenAI, addressing a significant gap in the existing body of knowledge. The methods employed included a systematic review using the PRISMA approach and thematic analysis to ensure comprehensive evaluation and synthesis of the findings.

Our findings illuminate the multifaceted role of GenAI in transforming educational methodologies, enhancing pedagogical approaches, and reshaping student-teacher interactions. The objectives of this study were to explore how GenAI is currently being applied in higher education, identify the challenges and limitations faced, and propose recommendations for future research and practice. The versatility of GenAI is evident in its various applications, ranging from the generation of teaching materials and skill development to academic performance evaluation and research support. The integration of GenAI tools like ChatGPT has demonstrated potential in not only augmenting the teaching and learning experience but also in facilitating administrative and research-related tasks. However, this study also uncovers critical challenges and limitations of GenAI. Issues such as the accuracy of the information, the risk of 'hallucinations,' and ethical concerns like plagiarism and dependency on AI for academic tasks underscore the need for a balanced and cautious approach toward implementing GenAI in educational settings. These findings suggest that while GenAI offers substantial benefits, it should be employed as a complementary tool rather than a replacement for traditional educational methods.

The research highlights a need for ongoing investigation into the evolving capabilities of GenAI models. New models, such as OpenAI's GPT-4o and Google's Gemini 1.5, released in May 2024, offer advanced features that could further enhance educational applications, emphasizing the importance of continuous development and evaluation. As these tools continue to develop, future research should focus on refining their application in education, exploring the potential for custom-built AI solutions, and addressing ethical considerations and academic integrity. Our study also recommends that educational institutions and policymakers should consider providing training and resources to educators and students for the effective use of GenAI tools. This could include developing skills in prompt engineering and understanding the nuances of AI-generated content, thereby ensuring that the integration of GenAI in education is both effective and responsible.

In conclusion, this paper contributes to the evolving discourse on GenAI in education, offering a foundational perspective on its current state, potential benefits, and challenges. The insights gained from this research are intended to guide future academic inquiries, pedagogical practices, and policy formulation in the realm of digital education and AI integration.

REFERENCES

Alneyadi, S., & Wardat, Y. (2023). ChatGPT: Revolutionizing student achievement in the electronic magnetism unit for eleventh-grade students in Emirates schools. *Contemporary Educational Technology*, *15*(4), Article ep448. https://doi.org/10.30935/cedtech/13417

Álvarez-Álvarez, C., & Falcon, S. (2023). Students' preferences with university teaching practices: Analysis of testimonials with artificial intelligence. *Educational Technology Research and Development*, *71*, 1709-1724. https://doi.org/10.1007/s11423-023-10239-8

Ansari, A. N., Ahmad, S., & Bhutta, S. M. (2023). Mapping the global evidence around the use of ChatGPT in higher education: A systematic scoping review. *Education and Information Technologies*. https://doi.org/10.1007/s10639-023-12223-4

Bahroun, Z., Anane, C., Ahmed, V., & Zacca, A. (2023). Transforming education: A comprehensive review of generative artificial intelligence in educational settings through bibliometric and content analysis. *Sustainability*, *15*(17), 12983. https://doi.org/10.3390/su151712983

Banks, J., & Warkentin, T. (2024, February 21). *Gemma: Introducing new state-of-the-art open models.* https://blog.google/technology/developers/gemma-open-models/

Barrett, A., & Pack, A. (2023). Not quite eye to AI: Student and teacher perspectives on the use of generative artificial intelligence in the writing process. *International Journal of Educational Technology in Higher Education*, 20, Article 59. https://doi.org/10.1186/s41239-023-00427-0

Barrett, J. S., Skolnik, J. M., Ingram, M., Kuo, Y. M., Metzloff, A. E., Jin, R., Wu, Y., & Kroushl, N. (2024). Engaging student opinions on vaccine development innovation: Experiences from a "Shark Tank" project. *Clinical and Translational Science*, *17*(2), e13723. https://doi.org/10.1111/cts.13723

Bonnet, W. (2023). *Using Quiz Wizard for language courses.* https://www.getquizwizard.com/articles/Emelina-Cucunuba-using-Quiz-Wizard-for-language-courses/

Boschetti, F. (2019). Semantic analysis and thematic annotation. In M. Berti (Ed.), *Digital classical philology: Ancient Green and Latin in the digital revolution* (pp. 321-339). De Gruyter Saur. https://doi.org/10.1515/9783110599572-018

Boyd, E. (2024, February 26). *Microsoft and Mistral AI announce new partnership to accelerate AI innovation and introduce Mistral Large first on Azure.* https://azure.microsoft.com/en-us/blog/microsoft-and-mistral-ai-announce-new-partnership-to-accelerate-ai-innovation-and-introduce-mistral-large-first-on-azure/

Cardoso, V. (2024). *Can Devin, the new AI, replace human software engineers?* https://medium.com/@cerebrovinny/can-devin-the-new-ai-replace-human-software-engineers-fd6fd117f8fd

Carrasco Rodriguez, A. (2023). Reinventing the teaching of early modern history in secondary school: The use of ChatGPT to enhance learning and educational innovation. *Studia Historica: Historia Moderna*, *45*(1), 101-145. https://doi.org/10.14201/shhmo2023451101146

Chaudhry, I. S., Sarwary, S. A. M., El Refae, G. A., & Chabchoub, H. (2023). Time to revisit existing student's performance evaluation approach in higher education sector in a new era of ChatGPT – A case study. *Cogent Education*, *10*(1), Article 2210461. https://doi.org/10.1080/2331186X.2023.2210461

Cooper, G. (2023). Examining science education in ChatGPT: An exploratory study of generative artificial intelligence. *Journal of Science Education and Technology*, *32*(3), 444-452. https://doi.org/10.1007/s10956-023-10039-y

Dai, Y., Lai, S., Lim, C. P., & Liu, A. (2023). ChatGPT and its impact on research supervision: Insights from Australian postgraduate research students. *Australasian Journal of Educational Technology*, *39*(4), 74-88. https://doi.org/10.14742/ajet.8843

Dasari, D., Hendriyanto, A., Sahara, S., Suryadi, D., Muhaimin, L. H., Chao, T., & Fitriana, L. (2024). ChatGPT in didactical tetrahedron, does it make an exception? A case study in mathematics teaching and learning. *Frontiers in Education*, *8*, 1295413. https://doi.org/10.3389/feduc.2023.1295413

Deike, M. (2024). Evaluating the performance of ChatGPT and Perplexity AI in business reference. *Journal of Business & Finance Librarianship*, *29*(2), 125–154. https://doi.org/10.1080/08963568.2024.2317534

Dinh, H., & Tran, T. K. (2023). EduChat: An AI-based chatbot for university-related information using a hybrid approach. *Applied Sciences*, *13*(22), 12446. https://doi.org/10.3390/app132212446

Galli, G. (2024, January 15). *Peeling back the curtain to unmask the wizard of AI: Considering the collaborative relationship between non-technical subject matter experts and artificial intelligence.* SSRN. https://doi.org/10.2139/ssrn.4694869

Grassini, S. (2023). Shaping the future of education: exploring the potential and consequences of AI and ChatGPT in educational settings. *Education Sciences*, *13*(7), 692. https://doi.org/10.3390/educsci13070692

Guo, K., & Wang, D. (2023). To resist it or to embrace it? Examining ChatGPT's potential to support teacher feedback in EFL writing. *Education and Information Technologies*, *29*, 8435–8463. https://doi.org/10.1007/s10639-023-12146-0

Guo, Y., & Lee, D. (2023). Leveraging ChatGPT for enhancing critical thinking skills. *Journal of Chemical Education*, *100*(12), 4876-4883. https://doi.org/10.1021/acs.jchemed.3c00505

Ha, Y. J., Hendrickson, S., Nagy, A., Sylvan, E., & Zick, T. (2023). *Exploring the impacts of generative AI on the future of teaching and learning.* Harvard University, Berkman Klein Center.

Heinrichs, J. (2024). Fireflies.ai review: The best AI notetaker for meetings? *Unite.AI*. https://www.unite.ai/fireflies-ai-review/

Hijriyah, L., Alias, A., & Sahabuddin, M. F. M. (2023). Exploring walkability research trends based on systematic literature review (SLR) by applying PRISMA. *Open House International*, *49*(1), 63-121. https://doi.org/10.1108/ohi-02-2023-0031

Hsu, M.-H. (2023). Mastering medical terminology with ChatGPT and Termbot. *Health Education Journal, 83*(4), 352-358. https://doi.org/10.1177/00178969231197371

Ibrahimov, V. (2023). *Visualise you academic research and literature review with Litmaps.* Medium. https://medium.com/@aiVugar/visualise-you-academic-research-and-literature-review-with-litmaps-7bda22e1f49c

Ismail, S. N., Ramli, A., & Aziz, H. A. (2021a). Influencing factors on safety culture in mining industry: A systematic literature review approach. *Resources Policy*, *74*, 102250. https://doi.org/10.1016/j.resourpol.2021.102250

Ismail, S. N., Ramli, A., & Aziz, H. A. (2021b). Research trends in mining accidents study: A systematic literature review. *Safety Science*, *143*, 105438. https://doi.org/10.1016/j.ssci.2021.105438

Jeon, J., & Lee, S. (2023). Large language models in education: A focus on the complementary relationship between human teachers and ChatGPT. *Education and Information Technologies*, *28*, 15873–15892. https://doi.org/10.1007/s10639-023-11834-1

Karakose, T., Demirkol, M., Yirci, R., Polat, H., Ozdemir, T. Y., & Tülübaş, T. (2023). A conversation with ChatGPT about digital leadership and technology integration: Comparative analysis based on human–AI collaboration. *Administrative Sciences*, *13*(7), 157. https://doi.org/10.3390/admsci13070157

Kirwan, A. (2023). ChatGPT and university teaching, learning and assessment: Some initial reflections on teaching academic integrity in the age of Large Language Models. *Irish Educational Studies*, 1-18. https://doi.org/10.1080/03323315.2023.2284901

Lesage, J., Brennan, R., Eaton, S. E., Moya, B., McDermott, B., Wiens, J., & Herrero, K. (2024). Exploring natural language processing in mechanical engineering education: Implications for academic integrity. *International Journal of Mechanical Engineering Education*, *52*(1), 88-105. https://doi.org/10.1177/03064190231166665

Lim, W. M., Gunasekara, A., Pallant, J. L., Pallant, J. I., & Pechenkina, E. (2023). Generative AI and the future of education: Ragnarök or reformation? A paradoxical perspective from management educators. *The International Journal of Management Education*, *21*(2), 100790. https://doi.org/10.1016/j.ijme.2023.100790

Lo, C. K. (2023). What is the impact of ChatGPT on education? A rapid review of the literature. *Education Sciences*, *13*(4), 410. https://doi.org/10.3390/educsci13040410

López-García, G., Jerez, J. M., Ribelles, N., Alba, E., & Veredas, F. J. (2021). Transformers for clinical coding in spanish. *IEEE Access*, *9*, 72387-72397. https://doi.org/10.1109/access.2021.3080085

Masters, K., Benjamin, J., Agrawal, A., MacNeill, H., Pillow, M. T., & Mehta, N. (2024). Twelve tips on creating and using custom GPTs to enhance health professions education. *Medical Teacher*, *46*(6), 752–756. https://doi.org/10.1080/0142159x.2024.2305365

McCallum, L. (2024). New takes on developing intercultural communicative competence: Using AI tools in telecollaboration task design and task completion. *Journal for Multicultural Education*, *18*(1/2), 153-172. https://doi.org/10.1108/jme-06-2023-0043

McHugh-Johnson, M. (2024). *100 things we announced at I/O 2024*. https://blog.google/technology/ai/google-io-2024-100-announcements/

Mhlanga, D. (2023). *FinTech and artificial intelligence for sustainable development: The role of smart technologies in achieving development goals*. Palgrave Macmillan. https://doi.org/10.1007/978-3-031-37776-1_17

Michalon, B., & Camacho-Zuñiga, C. (2023). ChatGPT, a brand-new tool to strengthen timeless competencies. *Frontiers in Education*, *8,* 1251163. https://doi.org/10.3389/feduc.2023.1251163

Michel-Villarreal, R., Vilalta-Perdomo, E., Salinas-Navarro, D. E., Thierry-Aguilera, R., & Gerardou, F. S. (2023). Challenges and opportunities of generative AI for higher education as explained by ChatGPT. *Education Sciences*, *13*(9), 856. https://doi.org/10.3390/educsci13090856

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *BMJ*, *339*, b2535. https://doi.org/10.1136/bmj.b2535

Mollick, E. (2024). *What OpenAI did*. https://www.oneusefulthing.org/p/what-openai-did

Mondal, H., Marndi, G., Behera, J. K., & Mondal, S. (2023). ChatGPT for teachers: Practical examples for utilizing artificial intelligence for educational purposes. *Indian Journal of Vascular and Endovascular Surgery*, *10*(3), 200-205. https://doi.org/10.4103/ijves.ijves_37_23

Ngo, A., Gupta, S., Perrine, O., Reddy, R., Ershadi, S., & Remick, D. (2024). ChatGPT 3.5 fails to write appropriate multiple choice practice exam questions. *Academic Pathology*, *11*(1), 100099. https://doi.org/10.1016/j.acpath.2023.100099

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods*, *16*(1). https://doi.org/10.1177/1609406917733847

OpenAI. (2024, May 13). *Hello GPT-4o*. https://openai.com/index/hello-gpt-4o/

Oppenlaender, J., Linder, R., & Silvennoinen, J. (2023). *Prompting AI art: An investigation into the creative skill of prompt engineering*. arXiv:2303.13534v2. https://doi.org/10.48550/arXiv.2303.13534

Ossa, C., & Willatt, C. (2023). Providing academic writing feedback assisted by Generative Artificial Intelligence in initial teacher education contexts. *European Journal of Education and Psychology*, *16*(2). https://doi.org/10.32457/ejep.v16i2.2412

Pavlik, J. V. (2023). Collaborating with ChatGPT: Considering the implications of generative artificial intelligence for journalism and media education. *Journalism & Mass Communication Educator*, *78*(1), 84-93. https://doi.org/10.1177/10776958221149577

Perkins, M. (2023). Academic integrity considerations of AI Large Language Models in the post-pandemic era: ChatGPT and beyond. *Journal of University Teaching & Learning Practice*, *20*(2). https://doi.org/10.53761/1.20.02.07

Popovici, M. D. (2023). ChatGPT in the classroom. Exploring its potential and limitations in a functional programming course. *International Journal of Human–Computer Interaction*, 1-12. https://doi.org/10.1080/10447318.2023.2269006

Porter, L. (2024). *Learn AI-assisted Python programming: With GitHub Copilot and ChatGPT*. Simon and Schuster.

Psiropoulos, D., Barr, S., Eriksson, C., Fletcher, S., Hargis, J., & Cavanaugh, C. (2016). Professional development for iPad integration in general education: Staying ahead of the curve. *Education and Information Technologies*, *21*, 209-228. https://doi.org/10.1007/s10639-014-9316-x

Qadir, J. (2023, May). Engineering education in the era of ChatGPT: Promise and pitfalls of generative AI for education. *Proceedings of the IEEE Global Engineering Education Conference, Kuwait*. https://doi.org/10.1109/educon54358.2023.10125121

Rose, R. (2023). *ChatGPT in higher education. Artificial intelligence and its pedagogical value.* University of North Florida Digital Pressbooks.

Ross, E. A. (2023). A new frontier: AI and ancient language pedagogy. *Journal of Classics Teaching*, *24*(48), 143-161. https://doi.org/10.1017/s2058631023000430

Ruiz-Rojas, L. I., Acosta-Vargas, P., De-Moreta-Llovet, J., & Gonzalez-Rodriguez, M. (2023). Empowering education with generative artificial intelligence tools: Approach with an instructional design matrix. *Sustainability*, *15*(15), 11524. https://doi.org/10.3390/su151511524

Sharadgah, T. A., & Sa'di, R. A. (2022). A systematic review of research on the use of artificial intelligence in English language teaching and learning (2015-2021): What are the current effects? *Journal of Information Technology Education: Research*, *21*, 337-377. https://doi.org/10.28945/4999

Smith, A., Hachen, S., Schleifer, R., Bhugra, D., Buadze, A., & Liebrenz, M. (2023). Old dog, new tricks? Exploring the potential functionalities of ChatGPT in supporting educational methods in social psychiatry. *International Journal of Social Psychiatry*, *69*(8), 1882-1889. https://doi.org/10.1177/00207640231178451

Tobler, S. (2024). Smart grading: A generative AI-based tool for knowledge-grounded answer evaluation in educational assessments. *MethodsX*, *12*, 102531. https://doi.org/10.1016/j.mex.2023.102531

Urrutia, F., & Araya, R. (2024). Who's the best detective? Large language models vs. traditional machine learning in detecting incoherent fourth grade math answers. *Journal of Educational Computing Research*, *61*(8), 187-218. https://doi.org/10.1177/07356331231191174

Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing and Health Science*, *15*(3), 398-405. https://doi.org/10.1111/nhs.12048

van den Berg, G., & du Plessis, E. (2023). ChatGPT and generative AI: Possibilities for its contribution to lesson planning, critical thinking and openness in teacher education. *Education Sciences*, *13*(10), 998. https://doi.org/10.3390/educsci13100998

Vartiainen, H., Tedre, M., & Jormanainen, I. (2023). Co-creating digital art with generative AI in K-9 education: Socio-material insights. *International Journal of Education Through Art*, 19(3), 405-423. https://doi.org/10.1386/eta_00143_1

Walters, W. H., & Wilder, E. I. (2023). Fabrication and errors in the bibliographic citations generated by ChatGPT. *Scientific Reports*, *13*, Article 14045. https://doi.org/10.1038/s41598-023-41032-5

White, J., Fu, Q., Hays, S., Sandborn, M., Olea, C., Gilbert, H., Elnashar, A., Spencer-Smith, J., & Schmidt, D. (2023). *A prompt pattern catalog to enhance prompt engineering with ChatGPT*. arXiv:2302.11382v1. https://doi.org/10.48550/arXiv.2302.11382

Yang, X., Wang, Q., & Lyu, J. (2023). Assessing ChatGPT's educational capabilities and application potential. *ECNU Review of Education*. https://doi.org/10.1177/20965311231210006

Zadorozhnyy, A., & Lai, W. Y. W. (2024). ChatGPT and L2 written communication: A game-changer or just another tool? *Languages*, *9*(1), 5. https://doi.org/10.3390/languages9010005

Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, *18*(3), 429-472. https://doi.org/10.1177/1094428114562629

APPENDIX: DATA EXTRACTED FROM THE 44 ARTICLES AND THEIR CLASSIFICATION INTO 7 THEMES

DOI	Title	Journal	Year of Publication	Research Method	Country where the study was	Name of Institution	Topic or subject matter of the study	Activities in which GenAI tools were used by faculty	Tools used (GenAI + Others)
10.1017/S2058631023000430	A New Frontier: AI and Ancient Language Pedagogy	Journal of Classics Teaching	2023	Experimental research	UK	University of Reading	Languages	Skill development	ChatGPT 3.5
10.3991/ijep.v13i8.45621	AI-Enhanced Auto-Correction of Programming Exercises: How Effective is GPT-3.5?	International Journal of Engineering Pedagogy	2023	Experimental research	Germany, Munich	Ludwig Maximilian University, Munich	Programming	Feedback Delivery	ChatGPT 3.5
10.1186/s41239-023-00425-2	AI-generated feedback on writing: insights into efficacy and ENL student preference	International Journal of Educational Technology in Higher Education	2023	Quasi-experimental research and surveys	Asia–Pacifc region	Liberal arts universities	Languages	Feedback Delivery	ChatGPT
10.3390/educsci13090885	AI-Supported Academic Advising: Exploring ChatGPT's Current State and Future Potential toward Student Empowerment	Education Sciences	2023	Exploratory qualitative research	USA	Elementary schools, New York	General studies	Feedback Delivery	ChatGPT
10.1021/acs.jchemed.3c00581	An Analysis of AI-Generated Laboratory Reports across the Chemistry Curriculum and Student Perceptions of ChatGPT	Journal of Chemical Education	2023	Qualitative and quantitative research	USA	Washington State University	Chemistry	Skill development	ChatGPT 3.5
https://doi.org/10.1111/dsji.12306	ChatGPT and Python programming homework	Journal of Innovative Education	2024	Experimental research	USA	College of Business, University of	Programming	Student task development support	ChatGPT, Python
10.21577/0100-4042.20230059	Artificial intelligence and chemistry teaching: a propaedeutic analysis of chatgpt in chemical concepts defining	Quimica Nova	2023	Qualitative research with a descriptive and interpretative approach.	Brasil	Universidade Federal Rural de Pernambuco	Chemistry	Generation of teaching materials	ChatGPT
10.1111/opo.13207	Assessing the utility of ChatGPT as an artificial intelligence-based large language model for information to answer questions on myopia	Ophthalmic and Physiological Optics	2023	Quantitative research	UK	Aston University, Birmingham	Medicine	Generation of teaching materials	ChatGPT 3.5
10.1080/02602938.2024.2301722	Can ChatGPT effectively complement teacher assessment of undergraduate students' academic writing?	Assessment & Evaluation in Higher Education	2024	Qualitative and quantitative research	China	Research universities in southern China	Academic writing	Academic performance evaluation	ChatGPT
https://hdl.handle.net/10125/73530	Can ChatGPT make reading comprehension testing items on par with human experts?	Language Learning & Technology	2023	Quantitative research	South Korea	College Scholastic Ability	Languages	Generation of teaching materials	ChatGPT
10.1016/j.acpath.2023.100099	ChatGPT 3.5 fails to write appropriate multiple choice practice exam questions	Academic Pathology	2023	Qualitative research	USA	Boston University Chobanian	Medicine	Generation of teaching materials	ChatGPT 3.5
10.3390/educsci13100998	ChatGPT and Generative AI: Possibilities for Its Contribution to Lesson Planning, Critical Thinking and Openness in Teacher Education	Education Sciences	2023	Qualitative research	SouthAfrica	University of South Africa, Pretoria	Languages	Generation of teaching materials	ChatGPT

DOI	Title	Journal	Year of Publication	Research Method	Country where the study was	Name of Institution	Topic or subject matter of the study	Activities in which GenAI tools were used by faculty	Tools used (GenAI + Others)
10.14742/ajet.8843	ChatGPT and its impact on research supervision: Insights from Australian postgraduate research students	Australasian Journal of Educational Technology	2023	Qualitative research and literature review	Australia	University of New South Wales, Sydney	Research	Research Support	ChatGPT
10.3390/languages9010005	ChatGPT and L2 Written Communication: A Game-Changer or Just Another Tool?	Languages	2023	Case analysis	Hong Kong	Education University of Hong Kong	Languages	Skill development	ChatGPT 3.5, ChatGPT 4.0, GPTZero &
10.1080/03323315.2023.2284901	ChatGPT and university teaching, learning and assessment: some initial reflections on teaching	Irish Educational Studies	2023	Case analysis	Maynooth	Maynooth University	General studies	Skill development	ChatGPT
10.4103/ijves.ijves_37_23	ChatGPT for teachers: Practical examples for utilizing artificial intelligence for educational	Indian Journal of Vascular & Endovascular Surgery	2023	Experimental research	India	AIIMS, Delhi	General studies	Generation of teaching materials	ChatGPT
10.3389/feduc.2023.1295413	ChatGPT in didactical tetrahedron, does it make an exception? A case study in mathematics teaching and learning	Frontiers in Education	2024	Qualitative and quantitative research	USA	universities of Indonesia	Education - General	Skill development	ChatGPT
10.30935/cedtech/13176	ChatGPT in physics education: A pilot study on easy-to-implement activities	Contemporary Educational Technology	2023	Quantitative research	Germany	University of Leipzig	Physics	Skill development	ChatGPT
10.1080/10447318.2023.2269006	ChatGPT in the Classroom. Exploring Its Potential and Limitations in a Functional	International Journal of Human–Computer Interaction	2023	Quantitative research	Romania	National University of Science and	Programming	Student task development support	ChatGPT
10.3389/feduc.2023.1251163	ChatGPT, a brand-new tool to strengthen timeless competencies	Frontiers in Education	2023	Experimental research	Mexico	Tecnologico de Monterrey	Languages	Skill development	ChatGPT
10.30935/cedtech/13417	ChatGPT: Revolutionizing student achievement in the electronic magnetism unit for eleventh-grade students in Emirates schools	Contemporary Educational Technology	2023	Quasi-experimental research	United Arab Emirates	Al Ain University	Electronic Magnetics	Skill development	ChatGPT
10.1386/eta_00143_1	Co-creating digital art with generative AI in K-9 education: Socio-material insights	International Journal of Education Through Art	2023	Qualitative research	Finland	University of Eastern Finland	Digital Art	Student task development support	DALL-E & Midjourney.
10.3390/mti7080081	Creative Use of OpenAI in Education: Case Studies from Game Development	Multimodal Technologies and Interaction	2023	Qualitative research	UK	London Metropolitan University	Programming	Student task development support	ChatGPT & Dall-E
10.3390/app132212446	EduChat: An AI-Based Chatbot for University-Related Information Using a Hybrid Approach	Applied Sciences	2023	Qualitative research	Vietnam	University of Foreign Languages and IT	General studies	Virtual assistant (chatbot)	Prolog y ChatGPT
10.1111/cts.13723	Engaging student opinions on vaccine development innovation: Experiences from a "Shark Tank" project	Clinical and Translational Science	2024	Experimental research	USA	University of Pennsylvania	Medicine	Student task development support	ChatGPT 3.5

DOI	Title	Journal	Year of Publication	Research Method	Country where the study was	Name of Institution	Topic or subject matter of the study	Activities in which GenAI tools were used by faculty	Tools used (GenAI + Others)
10.1177/0306419023116665	Exploring natural language processing in mechanical engineering education: Implications for academic integrity	International Journal of Mechanical Engineering Education	2024	Experimental research	Canadá	University of Calgary	Mechanical engineering	Student task development support	GPT-3 & Codex
10.1007/s10639-023-12249-8	Few-shot is enough: exploring ChatGPT prompt engineering method for automatic question	Education and Information Technologies	2022	Design and development research (DDR)	South Korea	(Not mentioned)	Languages	Generation of teaching materials	ChatGTP
10.2967/jnmt.123.266485	GPT-4 in Nuclear Medicine Education: Does It Outperform GPT-3.5?	Journal of Nuclear Medicine Technology	2023	Experimental research	Australia	Charles Sturt University, Wagga Wagga, New South Wales	Nuclear Medicine	Academic performance evaluation	ChatGPT 3.5 & ChatGPT 4.0
10.3390/bdcc8010002	Knowledge-Based and Generative-AI-Driven Pedagogical Conversational Agents: A	Big Data and Cognitive Computing	2023	Qualitative research	Germany	Karlsruhe University of Applied	General studies	Virtual assistant (chatbot)	ChatGPT 3.5, ChatGPT 4.0, LangChain &
10.1007/s10639-023-11834-1	Large language models in education: A focus on the complementary relationship between human teachers and ChatGPT	Education and Information Technologies	2023	Qualitative and quantitative research	South Korea	Hannam University	Languages	Skill development	LangChain, Chroma & ChatGPT.
10.1021/acs.jchemed.3c00505	Leveraging ChatGPT for Enhancing Critical Thinking Skills	Journal of Chemical Education	2023	Qualitative research	USA	Georgia Gwinnett College	Critical Thinking	Skill development	ChatGTP
10.1177/0017896923197371	Mastering medical terminology with ChatGPT and Tembot	Health Education Journal	2023	Experimental research	Taiwán	Chang Gung University of Science and	Medicine	Skill development	ChatGPT & Tembot
10.1108/JME-06-2023-0043	New takes on developing intercultural communicative competence: using AI tools in	Journal for Multicultural Education	2023	Experimental research	UK	Edinburgh Napier University	Intercultural communication	Skill development	ChatGTP
10.1186/s41239-023-00427-0	Not quite eye to AI: student and teacher perspectives on the use of generative artificial intelligence in	International Journal of Educational Technology in Higher Education	2023	Qualitative research	USA	Public research university	Writing process	Skill development	ChatGTP
10.1177/00207640231178451	Old dog, new tricks? Exploring the potential functionalities of ChatGPT in supporting educational methods in social psychiatry	International Journal of Social Psychiatry	2023	Qualitative research	Switzerland, UK	University of Bern, University of Zurich, King's College London	Psychiatry	Generation of teaching materials	ChatGTP 3.5
10.32457/ejep.v16i2.2412	Providing academic writing feedback assisted by Generative Artificial Intelligence in initial teacher education contexts	European Journal of Education and Psychology	2023	Experimental research	Chile	Universidad Autónoma de Chile	Academic writing	Feedback Delivery	ChatGTP 4.0

DOI	Title	Journal	Year of Publication	Research Method	Country where the study was	Name of Institution	Topic or subject matter of the study	Activities in which GenAI tools were used by faculty	Tools used (GenAI + Others)
10.1177/1094428123125024	Real Research with Fake Data: A Tutorial on Conducting Computer Simulation for Research and Teaching	Organizational Research Methods	2023	Descriptive research	USA	Rutgers University, Piscataway	Computer simulation (statistics)	Generation of teaching materials	Excel, Mplus, R & ChatGPT
10.14201/shhmo2023451101146	Reinventing the Teaching of Early Modern History in Secondary School: the use of ChatGPT to	Studia Historica. Historia Moderna	2023	Experimental research	Spain	University of Alicante	General studies	Generation of teaching materials	ChatGTP
10.1016/j.mex.2023.102531	Smart grading: A generative AI-based tool for knowledge-grounded answer evaluation in educational	MethodsX	2023	Experimental research	Switzerland	ETH Zurich University	General studies	Academic performance evaluation	ChatGPT
10.1007/s11423-023-10239-8	Students' preferences with university teaching practices: analysis of testimonials with artificial intelligence	Educational technology research and development	2023	Quantitative and qualitative research	Spain	University of Cantabria	General studies	Feedback Delivery	ChatGTP 3
10.1080/2331186X.2023.2210461	Time to Revisit Existing Student's Performance Evaluation Approach in Higher Education Sector in a New Era of ChatGPT - A Case	Cogent Education	2023	Quasi-experimental research	United Arab Emirates	Al Ain University	General studies	Academic performance evaluation	ChatGPT & Turnitin.
10.1007/s10639-023-12146-0	To resist it or to embrace it? Examining ChatGPT's potential to support teacher feedback in EFL writing	Education and Information Technologies	2023	Exploratory and comparative approach	China	The University of Hong Kong	Languages	Feedback Delivery	ChatGPT
10.4103/idoj.idoj_72_23	Using ChatGPT for Writing Articles for Patients' Education for Dermatological Diseases: A Pilot Study	Indian Dermatology Online Journal	2023	Empirical and observational approach.	India	All India Institute of Medical Sciences	Medicine	Generation of teaching materials	ChatGPT, Flesch-Kincaid readability calculator & Turnitin.
10.1177/07356331191174	Who is the Best Detective? Large Language Models vs. Traditional Machine Learning in Detecting Incoherent Fourth Grade Math Answers	Journal of Educational Computing Research	2024	Quantitative research	Chile	University of Chile	Math	Academic performance evaluation	GPT-3, BLOOM, YouChat

AUTHORS

Dr. Giulio F. Marchena Sekli is an Associate Professor and researcher at CENTRUM Católica Graduate Business School. Giulio holds a PhD in Strategic Business Administration and a master's degree in strategic business administration from the Pontificia Universidad Católica del Perú, as well as a Master of Business Administration from EADA Business School in Barcelona, Spain. His research focuses on generative artificial intelligence, innovation, and disruptive technologies. He has worked for several years in the banking sector and for multinationals in the technology sector.

Amy Y. Godo Bocanegra, MBA, is a professor at CENTRUM PUCP and also teaches at Cibertec, where she specializes in Agile Program Management and Agile Coaching. She instructs advanced courses in E-commerce, Digital Culture, Artificial Intelligence, Training and Development of Human Talent, Fintech Models, and Agile Methodologies. Amy holds both an MBA and a Master's in Leadership and possesses over ten years of experience in digital transformation. Previously, held significant roles at Rimac Seguros, Banco de Crédito del Perú (BCP), and YAPE, focusing on IT project management and digital innovation.

Dr. Jose Carlos Veliz is a professor and researcher at CENTRUM Católica Graduate Business School. Jose Carlos holds a PhD in Strategic Business Administration with an emphasis on higher education and innovation, and an MBA from the Pontificia Universidad Católica del Peru. He also holds a Master of Business Administration from Maastricht School of Management in the Netherlands, with a focus on higher education, dropout intention, and entrepreneurship. He has worked for several years and has held management and customer service positions in both the service and manufacturing sectors.